Geophysical Features of the Ore-Controlling Fault in the Chang’an Gold Deposit, Southern Yunnan Province

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The Ailao Mountain is one of the most important metallogenic belts of polymetallic deposits in the Sanjiang region, southwestern China. Located in the southern segment of this metallogenic belt, the newly-discovered Chang’an gold deposit is large in scale (Fig. 1A), and has attracted much attention among geologists. The ore-hosted rocks in the district include the Late Ordovician Xiangyang Fm. sandstone and clastic rocks and the Early Silurian Kanglang Fm. dolomite. Affected by the multi-stage tectonic activities, stocks and dykes of lamprophyre, dolerite, syenite porphyry and orthoclaseite are widely exposed, and the orebodies are in symbiosis with or crosscut the dyke rocks. These rocks may derive from comagmatic evolution materials, and the lamprophyre and dolerite have a closer relationship with the mineralization. In this deposit, the fractures generally trend NW–NNW, and the Ganhe and Jinpeng Faults are important rock-controlling and ore-controlling ones. The Chang’an gold ore bodies are mainly controlled by the brittle fault F6 (Fig. 1), and the mineralization dominantly occurred in cataclastic rocks and mylonites of various lithologies. The F6 fracture belt is a pathway for the upwelling of ore-bearing hydrothermal fluids, and also an ore-hosted place for ore fluid accumulation and precipitation. Therefore, it is of important significance for prospecting to determine the spatial distribution of F6.

Fig. 1. Simplified geological map of the Chang’an gold deposit in southern Yunnan Province.

1, Late Ordovician Haidong Formation; 2-6, Late Ordovician Xiangyang Formation; 7, Late Devonian Lanniquing Formation; 9, Early Devonian Gangou Formation; 10, Carboniferous Jianxiyin Formation; 11, Early Silurian Kanglang Formation; 12, orthoclaseite; 13, lamprophyre; 14, dolerite; 15, alteration zone; 16, syenite porphyry; 17, fault; 18, MT profile;

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During 2010–2011, the Yunnan Gold & Mining Group Co. Ltd. described the spatial distribution of F6 at depths of 0–500 m by the transient electromagnetic (TEM) method. The result shows that F6 generally trends NE near the surface and upright in the middle section, and trends W in the deep. Based on this, a new work idea of deep prospecting has been proposed, and major breakthroughs have been made—the gold resource amount has increased from 20 t to 40 t.

However, the detection depth of TEM is only a few hundred meters, which results in much incomplete delineation of low resistivity anomalies corresponding to F6 on the inversion resistivity section of TEM. Thus, this study deployed 4 MT profiles between the Chang’an and Yinchangpo gold deposits in order to further investigate the extension of F6 to the deep and its spatial distribution on the plane. The direction of the MT profile is 250°, vertical with the trend of F6, and the distance between points is 50 m (Fig. 1).

Our field MT investigation reveals that obviously low and mid-low resistance displays under F6 on the inversion resistivity sections, shown as the section along Line 2 (Fig. 1B). We can infer that F6 generally trends upright, with fault throw ranging from 100 to 400 m; the fault zone extends down to an elevation of about -400 m, which is about 2000 m beneath the surface. The MT method has therefore overcome the TEM shortage of limited detection depth. Combining with the understanding of mineralization, we consider that the main prospecting targets of the deposit should be along the fault strike or towards the deep of F6. The present exploration depth is limited within 500 m below the surface, and there will be the second prospecting space at depths of 500 to 2000 m under the surface, which is worth further investigation and research.

The Yinchangpo gold deposit is located about less than hundreds of meters south of the Chang’an gold deposit, with only oxide-bearing ores discovered in the shallow surface. It has been nearly mined out, but no sulphide ores have been found in this area. It is under debate that whether F6 extends to this area or whether there exist sulphide ores in the deep. A 3D visualization map made with the inversion resistivity parameters of the MT profiles (Fig. 1C) shows that, the blue area representing low resistivity bodies (fault structure belt) has a good continuity from Chang’an to Yinchangpo, and it corresponds well with the F6 position. It is suggested that these two gold deposits are both controlled by F6. There is also a good prospect potential in the deep Yinchangpo mining area, and its exploration model can refer to that of the Chang’an gold deposit.

In summary, this study generally determined the spatial distribution of F6 fault zone by the MT method, and suggests that there is a good prospecting potential in the deep Chang’an-Yinchangpo ore district. This may provide a reliable geophysical basis for the future prospect in this region.

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